FRENCH RIVER BASIN
DUDLEY, MASSACHUSETTS

LARNER POND DAM
MA 00111

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

AUGUST, 1978

NATIONAL PROGRAM OF INSPECTION OF NON-FEDERAL DAMS
DRAFT REPORT REVIEW COMMENTS

LARNER POND DAM, IDENTITY NO. MA 00111

FOUNDATIONS & MATERIALS BRANCH

Comment	Page No.	Comment
(1)	Genl.	Same comment (1) & (2) as in COOK POND DAM; reverse adjective rating (FAIR TO POOR) in Assessment & Section 7.
(2)	-	Use FIG. B-1 as photo location plan. Photos in "A" copy are available if you want them for final report.

General Comments

FOUNDATIONS & MATERIALS BRANCH

All four reports 00111, 00112, 00122, 00123 were good & reflect the format we are looking for. These comments are being made are minor to polish the latest policy guidelines. A WELL DONE to ME !!!

Tierney

UNCLASSIFIED

URITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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SUPPLEMENTARY NOTES
over program reads: Phase I Inspection Report, National Dam Inspection Program; owever, the official title of the program is: National Program for Inspection of on-Federal Dams; use cover date for date of report.

KEY WORDS (Continue on reverse side if necessary and identify by block number)
DAMS, INSPECTION, DAM SAFETY,
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Dudley, Massachusetts

ABSTRACT (Continue on reverse side if necessary and identify by block number)

Larner Pond Dam is a dry-stone masonry and earth dam. The dam has a maximum height of about 17 feet and is approximately 405 feet long. The dam is considered to be in fair to poor condition. It has been classified in the "high" hazard category.Based on size and hazard classification, the test flood is one-half the PMF.

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LARNER POND DAM

MA 00111

FRENCH RIVER BASIN
DUDLEY, MASSACHUSETTS

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION
PROGRAM

NATIONAL DAM INSPECTION
PROGRAM

PHASE I INSPECTION REPORT

BRIEF ASSESSMENT

Identification No.: MA00111

Name of Dam: Larner Pond

Town: Dudley

County and State: Worcester County, Massachusetts

Stream: Tributary of French River

Date of Inspection: June 26, 1978

Larner Pond Dam is a dry-stone masonry and earth dam which was constructed about 1830. The dam has a maximum height of about 17 feet and is approximately 405 feet long. It is comprised of an earth dike section approximately 160 feet long by 5 feet high on the east, and a dry-stone masonry and earth dam section 245 feet long 17 feet high on the west. Near the east end of the main dam is a stone masonry spillway with concrete apron approximately 38 feet long. Discharge flows down a stepped stone cascade into a natural earth channel. There are no plans, specifications, or computations available from the Owner, County, or State offices regarding the design, construction, or repairs of this dam.

Due to its age, Larner Pond Dam was neither designed nor constructed by current approved state-of-the-art procedures. Based upon the visual inspection at the site, the lack of engineering data available, and the lack of proper maintenance there are areas of concern which must be corrected to assure the continued performance of this dam. Generally the dam is considered to be in fair to poor condition. Larner Pond has been classified in the "high" hazard category.

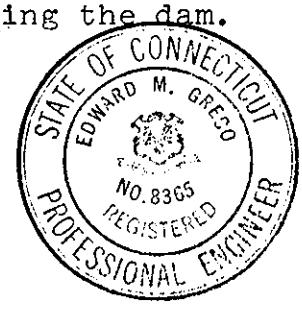
The areas of concern which indicate a potential hazard at the site include: seepage along the downstream toe of both the masonry wall of the dam and the dike, the loss of earthfill along the crest of the dam in various locations, a large depression on the crest

of the dam, large trees and brush growing on the dam, a deteriorated spillway, and uncontrolled flow under the spillway apron slab.

Hydraulic analyses indicate that the dam has insufficient freeboard not only for the inflow test flood but also for the 100-year storm. Based on size and hazard classifications in accordance with Corps guidelines, the test flood is one-half the probable maximum flood. The inflow test flood of 2,580 cfs adjusted for surcharge storage will result in 725 cfs flow through the spillway while flow over the dam crest is predicted to be 1,600 cfs at a depth of almost 2 feet. The spillway is inadequate since it can discharge only 9 percent of the test flood before the dam is overtopped. Overtopping would cause erosion along the dam crest and could cause failure of the dam.

It is recommended that the Owner employ a qualified consultant to investigate the seepage conditions, loss of fill and depression along the dam crest, and to conduct a more detailed hydrologic and hydraulic investigation.

The above recommendations should be implemented within a period of 1 year after receipt of the Phase I Inspection Report. An alternative to these recommendations would be draining the reservoir and breaching or removing the dam.



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This Phase I Inspection Report on Larner Pond Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

CHARLES G. TIERSCH, Chairman
Chief, Foundation and Materials
Branch
Engineering Division

FRED J. RAVENS, Jr., Member
Chief, Design Branch
Engineering Division

SAUL C. COOPER, Member
Chief, Water Control Branch
Engineering Division

APPROVAL RECOMMENDED:

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in Recommended Guidelines for Safety Inspection of Dams, for a Phase I Investigation. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there by any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general conditions and the downstream damage potential.

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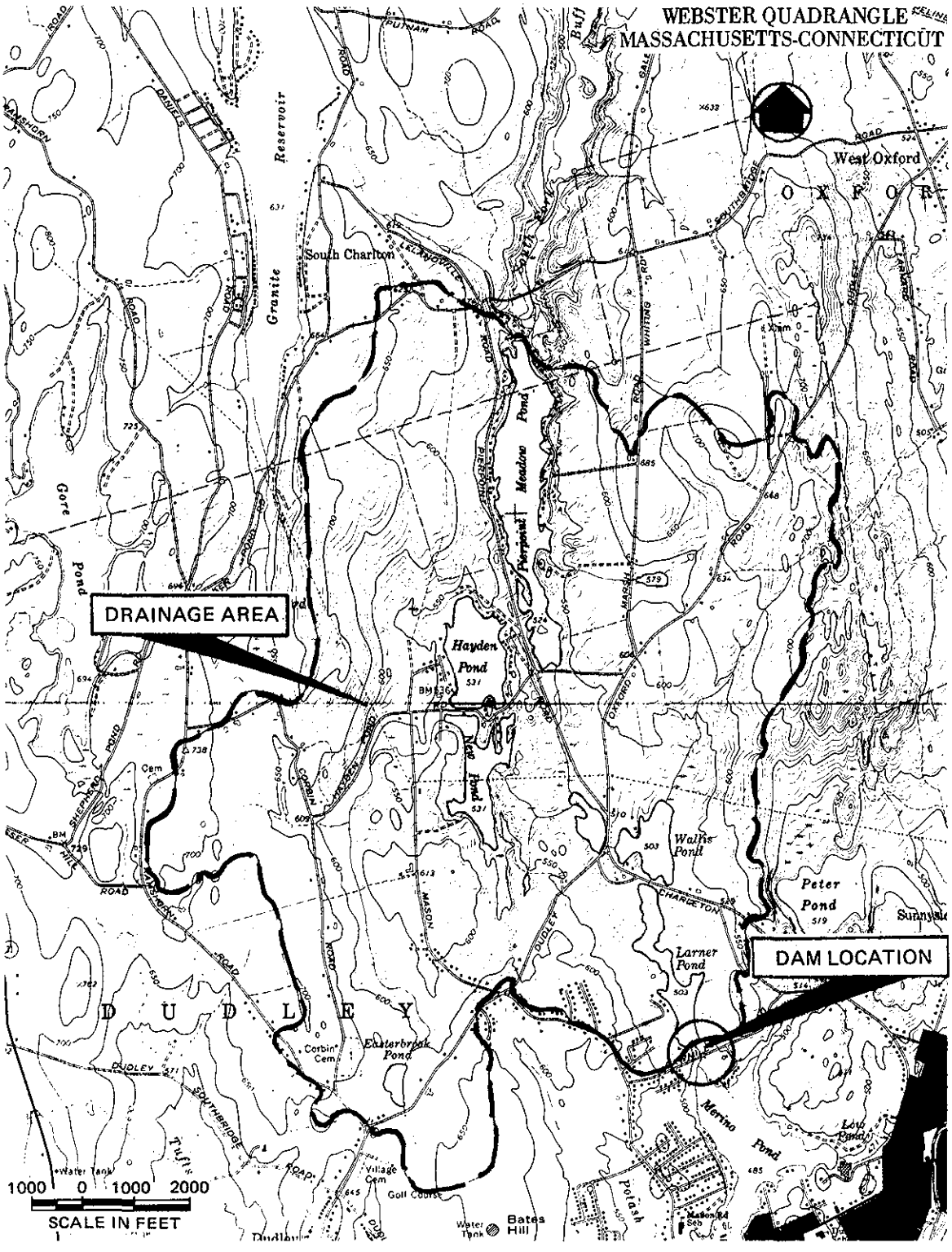
DUDLEY, MASSACHUSETTS

VIEW OF UPSTREAM FACE OF DAM



LOCATION MAP - LARNER POND DAM

NATIONAL DAM INSPECTION
PROGRAM

PHASE I INSPECTION REPORT

LARNER POND

SECTION 1

PROJECT INFORMATION

1.1 General

a. Authority. Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a national program of dam inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Metcalf & Eddy, Inc. has been retained by the New England Division to inspect and report on selected dams in the State of Massachusetts. Authorization and notice to proceed was issued to Metcalf & Eddy, Inc. under a letter of May 3, 1978, from Ralph T. Garver, Colonel, Corps of Engineers. Contract No. DACW 33-78-C-0306 has been assigned by the Corps of Engineers for this work.

b. Purpose:

(1) Perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.

(2) Encourage and assist the States to initiate quickly effective dam safety programs for non-Federal dams.

(3) To update, verify and complete the National Inventory of Dams.

1.2 Description of Project

a. Location. The dam is located in the Town of Dudley, Worcester County, Massachusetts, on an unnamed tributary of the French River.

b. Description of Dam and Appurtenances. Larner Pond Dam consists of a dry-stone masonry and earthfill dam section approximately 245 feet long and 17 feet high, and an earth dike section approximately 160 feet long and 5 feet high (see Appendix B, Figure B-1). The crest of the main dam is about 25 feet wide. The upstream and downstream slopes of the dam are vertical dry-stone masonry walls. The stones placed on the upstream wall are known to extend at least 10 feet deep (depth probed). The downstream wall was measured to be about 16 feet high. The main dam is relatively straight with minor surface irregularities along its crest, with the exception of a 7- foot diameter by 2-foot deep depression on the dam crest.

The dike embankment extends from the east end of the main dam at approximately a 45 degree angle upstream to the axis of the main dam. The width of the dike is approximately 8 feet at the crest. Upstream, the dike consists of a low stone masonry wall. The downstream earth dike slope is about 1 horizontal to 1 vertical.

The spillway is located on the dam about 150 feet east of the right dam abutment. The crest is a slightly sloped concrete apron (maximum El 503) placed over stone blocks and bounded by 2-foot wide mortared stone masonry training walls. The spillway crest is 37.5 feet long at the upstream end and 38.7 feet long at the downstream end. The downstream wall at the spillway consists of large (4.5-foot long) stone masonry steps descending to stream bottom approximately 14 feet from the crest. As shown in Appendix B, Figure B-1, the cascade section of the spillway extends an additional 45 feet east of the spillway. Below the cascade the spillway discharges into

the natural stream channel, which flows through a culvert under Sawmill Road about 250 feet downstream.

The only apparent outlet structure for the dam is a stone masonry conduit about 2 feet by 2 feet situated approximately 65 feet west of the centerline of the spillway. A vertical valve shaft is located in a locked metal box on the upstream face of the dam above the inlet. According to the Owner, the box contains hydrualic jacks which are used to raise and lower the gate, controlling the outlet flow.

c. Size Classification. Larner Pond Dam is classified as "small" since it has a maximum height of 17 feet and a maximum storage capacity of 240 acre-feet.

d. Hazard Classification. There are about 10 homes situated off Sawmill Road immediately downstream from the dam. Should the dam fail, the resulting flood wave could cause damage to property and some loss of life in the immediate area. In addition, the Town of Webster is located about one mile downstream. A flood wave due to failure at Larner Pond Dam could cause overtopping and possible failure of both additional downstream dams between Larner Pond and the Town of Webster. If this occurs, there would be considerable damage and possible loss of life in the Town of Webster. Accordingly, the dam is placed in a "high" hazard category.

e. Ownership. The dam is presently owned by the Stevens Linen Company, P.O. Box 220, Webster, Massachusetts, Mr. Robert Javery of Stevens Linen (617-943-0600) granted permission to enter the property and inspect the dam.

f. Operator. The Stevens Linen Company has the key for the gate valve box and are the only operators of the dam.

g. Purpose of the Dam. Larner Pond, also known as Larned Pond, was originally used as a storage dam for a saw and grist mill located downstream. The mill is no longer there. Subsequently, the dam became the property of

the Stevens Linen Company. Water from the pond along with water from two lower ponds is currently used for various operations in the textile factory. Residents in the area also use the pond for recreation.

h. Design and Construction History. The dam was originally constructed in 1830. There are no plans, specifications, or computations available from the Owner, County, or State offices relative to the design, construction, or repairs of this dam. Previous inspection reports at the Worcester County Commissioner's office indicate that the original timber spillway crest was rebuilt with concrete and stone in 1937. Subsequent inspection reports note seepage in several areas of the dam, but make no mention of repairs. It appears from one report that the "flume was blocked and abandoned" prior to 1942 but was still leaking. According to the Owner, however, the present outlet gate is operational and used to supply water to the lower ponds.

i. Normal Operational Procedure. The Owner states that the gate outlet conduit is opened every spring, and periodically when water is needed in the downstream ponds.

The spillway at the dam is ungated and flows over the crest are unrestricted. At the time of the inspection the pond level was 0.6 feet below the assumed benchmark (EL. 503) on the spillway crest. However, water was observed flowing beneath the spillway apron into the stone blocks that comprise the cascade.

1.3 Pertinent Data

a. Drainage Area. The drainage area above Larner Pond dam is approximately 3,000 acres (4.7 square miles) of gently rolling wood and farmland, and limited residential development along seven residential roads. Wallis Pond and an unnamed pond west of Wallis are at the same elevation as Larner Pond, and are separated from Larner Pond only by two road culverts. These two ponds, plus New Pond,

Hayden Pond, and Pierpont Meadow Pond account for 226 acres, or 7.5 percent of the total drainage area.

b. Discharge at the Dam Site. Water above El 503 would normally flow over the concrete apron on the spillway, down the cascade, and into a natural stream channel which has a streambed elevation of 488.2. The discharge flows approximately 250 feet south to a culvert under Sawmill Road, and into Merino Pond.

The spillway can discharge an estimated 200 cfs at El 504.4 which is the dam crest. An inflow test flood of 2,580 cfs (one half the probable maximum flood), adjusted for surcharge storage results in a maximum discharge of 2,325 cfs. This outfall will overtop the main dam by 1.9 feet. The maximum flood at the dam site is unknown; however, records at the Worcester County Engineer's Office state that the dam was not overtopped during the 1955 floods.

c. Elevation (feet above Mean Sea Level). A benchmark elevation of 503 at the spillway crest was estimated from a United States Geological Survey (USGS) topographic map.

(1) Main dam: 504.4 to 505.8 Dike section: 504.8 to 505.3

(2) Test flood pool: 506.3

(3) Design surcharge (original design): unknown

(4) Full flood control pool: N/A

(5) Recreation pool: 503 (spillway crest)

(6) Spillway crest (ungated): 503

(7) Upstream portal invert diversion tunnel: N/A

(8) Stream bed at centerline of dam: 488.2 (Invert of outlet conduit)

(9) Tailwater: 489 at outlet structure
488 at spillway

d. Reservoir

(1) Length of maximum pool: 3,200 feet

(2) Length of recreation pool: 3,200 feet

(3) Length of flood control pool: N/A

e. Storage (acre-feet)

(1) Test flood surcharge: 90 at EL 506.3

(2) Top of dam: 240 (approximate)

(3) Flood control pool: N/A

(4) Recreation pool: 200 (approximate)

(5) Spillway Crest: 200

f. Reservoir Surface (acres) (Assuming that the surface area will not significantly increase with changes in reservoir elevation from 503 to 504.4)

(1) Top dam: 27

(2) Test flood pool: 27

(3) Flood-control pool: N/A

(4) Recreation pool: 27

(5) Spillway crest: 27

g. Dam

(1) Type - Main dam: dry-stone masonry and earthfill
Dike section: earth

(2) Length - Main dam: 245 feet
Dike section: 160 feet

(3) Height - Main dam: (maximum) 17 feet
Dike section: 5 feet

(4) Top width - Main dam: 25 feet
Dike section: 8 feet (varies)

(5) Side slopes - Main dam: Upstream and downstream vertical walls
Dike section: Upstream: stone masonry wall
Downstream: earth slope 1:1

(6) Zoning: Unknown

(7) Impervious core: possibly timber and puddled clay core

(8) Cutoff: Unknown

(9) Grout curtain: Unknown

i. Spillway

(1) Type: Broad crest

(2) Crest length: 37.5 upstream, 38.7 downstream

(3) Crest elevation: 503 MSL (assumed benchmark)

(4) Gates: None

(5) Upstream Channel: No approach or side walls

(6) Downstream channel: cascade section: 85-feet wide, eight placed stoneblock steps descend a total of 17.2 feet to channel at natural ground

(7) General: Spillway channel below cascade flows 250 feet south to culvert under Sawmill Road.

j. Regulating Outlets. The apparent regulating outlet is a stone masonry conduit which extends from the upstream wall, under the dam to the downstream wall. The outlet has a capacity of 92 cfs (19.6 cfs per square mile). The invert for the conduit outlet is at El 488.2 feet. The gate for the conduit is reportedly operated by means of a hydraulic jack inside a locked metal box. The box overhangs the upstream wall of the dam, and is mounted on I-beams on a concrete frame. Details on the construction of the

gate valve and conduit inside the dam are unknown. Water is discharged at the base of the downstream wall and empties into an overgrown swampy area. A poorly defined outlet channel continues for approximately 50 feet southeasterly where it joins the spillway channel.

SECTION 2

ENGINEERING DATA

2.1 General. There are no plans, specifications, or computations available from the Owner, State, or County offices relative to the design, construction, or repairs of this dam. The only data available for this evaluation were visual observations during inspection, review of previous inspection reports, and conversations with the Owner and personnel from the State and County agencies.

We acknowledge the assistance and cooperation of personnel of the Massachusetts Department of Public Works: Messrs. Willis Regan and Raymond Rochford, and of the Massachusetts Department of Environmental Quality Engineering, Division of Waterways: Messrs. John J. Hannon and Joseph Iagallo.

Also, we acknowledge the cooperation and assistance of personnel from the Worcester County Engineer's Office: Messrs. John O'Toole, Joseph Brazauskas, and Mr. Wallace Lindquist - recently retired from county service.

Further assistance was provided by Mr. Robert Javery of the Stevens Linen Company.

2.2 Construction Records. There are no detailed construction records available.

2.3 Operation Records. No operation records are available, and there is no daily record kept of pool elevation or rainfall at the dam site.

2.4 Evaluation

a. Availability. Due to the age of this dam, there is limited engineering data available.

b. Adequacy. The lack of in-depth engineering data did not allow for a definitive review. Therefore the adequacy of this dam could not be assessed from the standpoint of reviewing

design and construction data, but is based primarily on visual inspection, past performance history and sound engineering judgment.

c. Validity. The limited engineering data available is valid.

SECTION 3

VISUAL INSPECTION

3.1 Findings

a. General. The Phase I inspection of the dam at Larner Pond was conducted on June 26, 1978. A copy of the inspection report is included in Appendix A. Periodic inspections of this dam by others have been made since 1925 and a listing of these inspections is in Appendix B. An inspection was made by the Massachusetts Department of Public Works in 1972. A copy of their report is included in Appendix B. In addition, earlier inspection reports were reviewed at the Worcester County Engineer's office.

b. Dam. The main dam is constructed of dry-stone masonry and earthfill. At the time of the inspection the dam crest was overgrown with grass, shrubs and trees to 36 inches in diameter. A footpath was observed along the crest. A 7-foot diameter by 2-foot deep depression was noted on the downstream side of the crest, just east of the outlet conduit. Also, near the inlet structure, some of the embankment has apparently been washed out behind the upstream wall.

The upstream face of the dam is mostly submerged but appears to be vertical and constructed of stone masonry. The visible upper 1 to 2-foot section shows several capstones missing. The downstream face, also constructed of stone masonry, is vertical and appears relatively sound. Seepage, however, is visible along the downstream wall, from the outlet east to the spillway, extending from 3 to 5 feet high along the wall to the ground. The wall is damp and water was observed at the toe near the spillway.

Midway from the outlet to the west abutment is an earth and stone buttress extending roughly 15 feet off the downstream wall (see Figure B-1, Appendix B).

On the eastern side of the spillway, and along the dike, the upstream stone walls are in fair condition, although some capstones are missing on both the dam and dike section. Downstream the vertical wall ends at the dam/dike transition, and the dike face slopes steeply to a swampy area. Near the transition end there is a small amount of seepage from what could be the remains of an additional outlet structure (roughly a 2-foot wide by 1-foot high sluiceway).

The entire downstream area of the dam and dike is overgrown by shrubs and trees, and is generally wet due to seepage from points along the downstream wall and toe of dike.

c. Appurtenant Structures. The outlet conduit is probably a stone box conduit. The only part visible was the 2 by 2-foot opening in the downstream wall. Leakage through the outlet at the time of the inspection was estimated at 2 to 5 gpm. The channel below the outlet is poorly defined, and covered with heavy vegetation.

A metal box housing the gate control mechanism is in fair condition. The box was locked but the Owner reports that the gate is in operating condition.

There is no apparent approach apron on the upstream end of the spillway. The only visible structure is a concrete sill submerged about 2 feet below the spillway crest. The 2-1/2-inch concrete apron on the crest is in poor condition - water was observed flowing under the apron and over the stone blocks and could be seen through an approximately 1-foot diameter hole on the crest.

Also at the upstream end a large section of concrete is missing from the northeast corner and the stone blocks are exposed. On the downstream end the concrete apron overhangs the first stone block step on the cascade and is deteriorating.

The training walls on the spillway crest have patches of mortar remaining, and some of the blocks have fallen into the spillway. The walls are no longer continuous. At the southwest end the wall is completely covered by heavy vegetation.

The cascade is in good condition. At the time of the inspection there was no water flowing over the spillway. Water, however, could be heard flowing through the spillway entering the channel below. The stream channel is covered by vegetation.

d. Reservoir Area. There are few residences on the perimeter of Larner Pond; most of the development is concentrated downstream along Sawmill Road and west along Mason Road. The rest of the drainage area is woodland and farmland with average slope of 1.3 percent. Pierpont Meadow Pond and Hayden Pond on the northern half of the drainage area are moderately developed.

e. Downstream Channel. Water from the spillway and the outlet conduit flows down the natural stream channel and under a double culvert (two corrugated metal pipes) under Sawmill Road. There are about 10 homes situated off Sawmill Road immediately downstream of the dam. From there the water immediately enters Merino Pond and then into Lower Merino Pond. The Town of Webster is located about one mile downstream of the dam.

3.2 Evaluation. The above findings indicate several areas of concern at the dam. In particular, seepage along the downstream wall of the dam; seepage at the toe of the dike; loss of fill material from the crest, and the deteriorated spillway crest require attention.

SECTION 4

OPERATING PROCEDURES

4.1 Procedures. According to the Owner, the outlet gate is opened every spring, and periodically when water is required in one of the downstream mill reservoirs.

4.2 Maintenance of Dam. The Owner states that the dam is cleared of brush, inspected annually in the spring, and checked after periods of high rain. The overgrowth of vegetation and the number of large trees on the dam indicates that the maintenance program has been inadequate.

4.3 Maintenance of Operating Facilities. The box housing the gate valve was recently repaired, and the Owner states that the screw mechanism was at some time replaced by hydraulic jacks. The leakage around the outlet conduit requires attention.

4.4 Description of Any Warning System in Effect. There are no warning systems in effect at this dam. The Owner stated that the dam is checked after periods of heavy rainfall.

4.5 Evaluation. The program of inspection and repair followed by the Owner should be expanded and made systematic, since this dam is in the "high" hazard category. Although some maintenance has been done, it appears to be limited to minor repairs.

SECTION 5

HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. Design Data. The Probable Maximum Flood (PMF) was determined to be 1,100 cfs per square mile. This calculation is based on the average drainage area slope of 1.3 percent, the pond-plus-swamp-area to drainage-area ratio of 10.2 percent, as well as the U. S. Army Corps of Engineers' guide curves for Maximum Probable Flood Peak Flow Rates (dated December 1977). Applying one-half the PMF maximum flood rate to the 4.7 square miles of drainage area results in a calculated peak flood flow of 2,580 cfs as the inflow test flood. By adjusting the inflow test flood for surcharge storage, the maximum discharge rate was established as 2,325 cfs (495 cfs per square mile), with a water surface at El 506.25.

Flow over the dam crest is computed to be 1,600 cfs, while flow through the spillway section would be 725 cfs. The maximum head on the dam would be 1.9 feet at a discharge of 6.68 cfs per foot of width. A flow having a 1.12-foot depth and a velocity of 6.0 feet per second would occur where flow becomes critical over the dam crest.

Hydraulic analyses indicate that the existing spillway can discharge a flow of 200 cfs at El 504.4, which is the dam crest.

b. Experience Data. Limited experience records are available for this dam. Conversations with Mr. W. Lindquist indicated that the dam was not overtopped in the 1955 flood.

c. Visual Observations. The spillway is located on the dam about 150 feet east of the

right dam abutment. The crest is a flat concrete weir placed over stone blocks and bounded by 1.5-foot high training walls. The crest is 37.5 feet long at the upstream end and 38.7 feet long at the downstream end. The width of the crest is 27.8 feet. The spillway discharges into a natural stream channel which flows through a culvert under Sawmill Road about 250 feet away.

d. Overtopping Potential. Hydraulic analyses indicate that the spillway can discharge only 200 cfs. Overtopping of the dam will not only occur under the inflow test flood but also the 100-year storm flood. The 100-year storm outflow is predicted to be 900 cfs at pond El. 505.4 which is 1 foot above the dam crest.

However, the dam is about 150 years old and has no history of failure and/or overtopping. The dam flood flows are probably attenuated by upstream retention in other ponds and swamps. Future development in the watershed area may increase the present runoff conditions and increase flood flows at the dam site.

Failure of the dam would produce a peak discharge of 5,900 cfs, as estimated using U.S. Corps of Engineers criteria, with a flood wave in the order of 9 feet. This flood would be partially impeded by Sawmill Road, before reaching Merino Pond.

The total pond volume would take about 0.7 hours to drain into Merino Pond and would raise its level about 1.8 feet. The flood wave could damage several residences on Merino Pond, although the effects would be mitigated by Sawmill Road.

SECTION 6

STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations. The evaluation of the structural stability of Larner Pond Dam is based on the visual inspection on June 26, 1978. Based on the observations as detailed in Section 3, Visual Inspection, Larner Pond Dam may be a hazard. The condition of the dam is unsatisfactory and conventional factors of safety may not exist.

Seepage, exiting along the downstream face of dam and toe of dike, alone or in combination with loss of material from the crest are major factors contributing to marginal conditions. It is recommended that a more detailed investigation be initiated to evaluate these areas of concern.

b. Design and Construction Data. Discussions with the Owner, Town, County, and State personnel indicate that there are no plans, specifications, or computations relative to the design, construction, or repairs of this dam. Information on the type, shear strength, and permeability of the soil and/or rock materials of the dam embankment is not available.

c. Operating Records. There is no evidence of instrumentation of any type in Larner Pond Dam, and there is nothing to indicate that any instrumentation was ever installed in this dam. The performance of this dam under prior loading can only be inferred by previous records and physical evidence at the site.

d. Post-Construction Changes. There are no as-built drawings for Larner Pond Dam. Review of inspection reports and discussions with County personnel and the Owner indicate that some changes and/or repairs have been made since 1925. These include rebuilding the spillway crest from timber to concrete and stone, and installing hydraulic jacks to operate the outlet gate.

e. Seismic Stability. The dam is located in Seismic Zone No. 2 and in accordance with Phase I "Recommended Guidelines" does not warrant seismic analyses.

SECTION 7

ASSESSMENT, RECOMMENDATIONS, AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. Due to its age, Larner Pond Dam was neither designed nor constructed to the current approved state-of-the-art procedures. Based upon the visual inspection at the site, there are areas of concern which must be corrected to assure the continued performance of this dam.

Generally, the dam is considered to be in fair to poor condition. The areas of concern include seepage at the downstream toe of the dam and dike, and loss of fill and a large depression along the dam crest, large trees and brush growing on the dam, a deteriorated spillway, and uncontrolled flow under the spillway apron slab. The large depression on the dam crest may indicate a piping condition along the outlet conduit which should be investigated further. In addition, brush and trees along the dam may cover potentially serious conditions.

Hydraulic analyses indicate the existing spillway can discharge a flow of 200 cfs at El 504.4, which is the dam crest. The spillway is inadequate since it can discharge only 9 percent of the test flood before the dam is overtopped. An inflow test flood of 2,580 (one-half the probable maximum flood) will overtop the main dam by about 1.9 feet. Since previous records at this site indicate the dam at its present elevation was not overtopped in the 1955 flood, it is unlikely that this is a serious hazard. However, it is not known what the pond elevation was prior to the 1955 storm. Possibly the pond was at a seasonal low elevation thereby providing sufficient storage to lessen the effects of the rainfall. Also the pond level may have been intentionally lowered because of the impending storm. Evidently, upstream storage in other ponds and swamps minimizes the possibility of overtopping at this dam. However, future development in the

watershed area could increase the runoff and peak flows and could create a more serious hazard.

b. Adequacy of Information. The lack of in-depth engineering data did not allow for a definitive review. Therefore the adequacy of this dam could not be assessed from the standpoint of reviewing design and construction data, but is based primarily on visual inspection, past performance history and sound engineering judgment.

c. Urgency. The recommendations outlined below should be implemented within one year after receipt of the Phase I inspection report.

d. Need for Additional Information. Additional investigations to further assess the adequacy of the dam and appurtenant structures are outlined below in Section 7.2 Recommendations.

7.2 Recommendations. In view of the concerns for the continued performance of this dam, it is recommended that the Owner employ a qualified consultant to:

a. Evaluate the dam stability particularly the seepage and loss of fill and large depression along the dam crest;

b. Conduct a more detailed hydrologic and hydraulic investigation for the entire drainage area. The purpose of the investigation is to determine whether a means should be provided for discharging a greater portion of the test flood.

The recommendations for repairs and maintenance procedures are stated below under Section 7.3 Remedial Measures.

7.3 Remedial Measures

a. Alternatives. An alternative to the recommendations above and repairing the dam and providing proper maintenance and scheduled inspection would be draining the reservoir and breaching or removing the dam.

b. Operation and Maintenance Procedures. The dam and appurtenances are not adequately maintained. It is recommended that the Owner accomplish the following:

(1) replace the fill along the dam crest after a detailed investigation as to the cause of the large depression in the crest just west of the spillway,

(2) repair the concrete weir and sidewalls on the spillway,

(3) remove the brush and large trees from the dam,

(4) clear all debris and brush from the channel below the spillway, and from the outlet channel,

(5) institute a program for surveillance and a warning system during periods of unusually heavy rains and/or runoff, and

(6) implement a systematic program of inspection and maintenance. As a minimum, the inspection program should consist of a monthly inspection of the dam and aptenances. This should be undertaken in accordance with all applicable State regulations.

APPENDIX A

PERIODIC INSPECTION CHECKLIST

PERIODIC INSPECTION

PARTY ORGANIZATION

PROJECT Larner Pond Dam

DATE 6/26/78

TIME 8:00 am

WEATHER warm and sunny

W.S. ELEV. 502.4 U.S. 488.3 DN.S.

Assumed benchmark elevation 503 at spillway crest

PARTY:

1. Richard Weber
2. Lyle Branagan
3. Ed Greco
4. Carol Sweet
5. Susan Pierce
6. M. Pacillo
7.
8.
9.
10.

	PROJECT FEATURE	INSPECTED BY	REMARKS
1.	Dam	Richard Weber	
2.	Spillway	Lyle Branagan	
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

PERIODIC INSPECTION CHECK LIST

PROJECT Lamer Pond DATE 6/26/78

PROJECT FEATURE Dam NAME R. Weber

DISCIPLINE Geotechnical NAME E. Greco

AREA EVALUATED	CONDITIONS
DAM EMBANKMENT	
Crest Elevation	varies from 504.0 to 505.8
Current Pool Elevation	502.4
Maximum Impoundment to Date	unknown
Surface Cracks	depression on crest 7x7 ft x 2 ft deep
Pavement Condition	n/a
Movement or Settlement of Crest	surface irregular
Lateral Movement	none visible
Vertical Alignment	downstream (and upstream?) walls vertical
Horizontal Alignment	relatively straight
Condition at Abutment and at Concrete Structures	right abutment natural ground left abutment transition to dike
Indications of Movement of Structural Items on Slopes	upstream wall right of spillway: capstones dislodged and missing; erosion on u/s face; washout behind u/s outlet headwall
Trespassing on Slopes	small trees; footpath along crest
Sloughing or Erosion of Slopes or Abutments	erosion of upstream face near right spillway training wall
Rock Slope Protection - Riprap Failures	no riprap
Unusual Movement or Cracking at or near Toes	none visible
Unusual Embankment or Downstream Seepage	swampy area along d/s toe seepage visible only at outlet
Piping or Boils	none visible
Foundation Drainage Features	unknown
Toe Drains	unknown
Instrumentation System	none visible

PERIODIC INSPECTION CHECK LIST

PROJECT Larner Pond DATE 6/26/78

PROJECT FEATURE Dike NAME R. Weber

DISCIPLINE Geotechnical NAME E. Greco

AREA EVALUATED	CONDITION
DIKE EMBANKMENT	
Crest Elevation	varies from 504.8 to 505.3
Current Pool Elevation	502.4
Maximum Impoundment to Date	unknown
Surface Cracks	none visible
Pavement Condition	n/a
Movement or Settlement of Crest	crest surface irregular
Lateral Movement	none visible
Vertical Alignment	irregular crest
Horizontal Alignment	dike crest is "S"-shaped from main dam to left dike abutment
Condition at Abutment and at Concrete Structures	abutment ties into natural ground
Indications of Movement of Structural Items on Slopes	none visible
Trespassing on Slopes	large trees (36", 12") and brush; footpath; pipe tying into pond
Sloughing or Erosion of Slopes or Abutments	upstream slope near dam abutment missing some capstones
Rock Slope Protection - Riprap Failures	stones placed irregularly on upstream slope
Unusual Movement or Cracking at or near Toes	none visible
Unusual Embankment or Downstream Seepage	swampy, moist, as evidenced by vegetation; standing water at d/s toe.
Piping or Boils	none visible
Foundation Drainage Features	unknown
Toe Drains	unknown
Instrumentation System	unknown

PERIODIC INSPECTION CHECK LIST

PROJECT Larner Pond DATE 6/26/78

PROJECT FEATURE Intake NAME L. Branagan

DISCIPLINE Geotechnical - Hydraulic NAME E. Greco

AREA EVALUATED	CONDITION
OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE	
a. Approach Channel	not visible
Slope Conditions	" "
Bottom Conditions	" "
Rock Slides or Falls	" "
Log Boom	" "
Debris	" "
Condition of Concrete Lining	" "
Drains or Weep Holes	" "
b. Intake Structure	" "
Condition of Concrete	" "
Stop Logs and Slots	" "

PERIODIC INSPECTION CHECK LIST

PROJECT Larner Pond DATE 6/26/78

PROJECT FEATURE outlet NAME L. Branagan

DISCIPLINE Geotechnical - Hydraulic NAME E. Greco

AREA EVALUATED	CONDITION
* OUTLET WORKS - TRANSITION AND CONDUIT	
General Condition of Concrete	2 x 2 ft opening in stone masonry
Rust or Staining on Concrete	n/a
Spalling	"
Erosion or Cavitation	"
Cracking	"
Alignment of Monoliths	roughly regular
Alignment of Joints	n/a
Numbering of Monoliths	"

* Outlet control is vertical valve shaft which enters locked box above water level. Box is reported to contain hydraulic jacks to lift and lower valve.

PERIODIC INSPECTION CHECK LIST

PROJECT Larner Pond DATE 6/26/78

PROJECT FEATURE Outlet NAME R. Weber

DISCIPLINE Geotechnical NAME E. Greco

AREA EVALUATED	CONDITION
OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL	
General Condition of Concrete	headwall d/s side unmortared stone masonry
Rust or Staining	n/a
Spalling	"
Erosion or Cavitation	"
Visible Reinforcing	"
Any Seepage or Efflorescence	seepage 5 ft west of outlet leakage at outlet, estimated 2-5 gpm *
Condition at Joints	joints open; condition fair to good
Drain Holes	none visible
Channel	small pool, few stones
Loose Rock or Trees Overhanging Channel	trees to 12-inch diameter
Condition of Discharge Channel	poor -- cluttered with brush and debris

* slight seepage 10 feet east of spillway. Also, general area of seepage along headwall from just east of outlet to spillway, 3 to 5 feet high along wall.

Flow from outlet conduit travels southeast approximately 50 feet to join flow from spillway.

PERIODIC INSPECTION CHECK LIST

PROJECT Larner Pond DATE 6/26/78

PROJECT FEATURE Spillway NAME L. Branagan

DISCIPLINE Hydraulics NAME E. Greco

AREA EVALUATED	CONDITION
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
a. Approach Channel	none
General Condition	
Loose Rock Overhanging Channel	
Trees Overhanging Channel	
Floor of Approach Channel	
b. Weir and Training Walls	2 1/2 - inch concrete cap over stone masonry
General Condition of Concrete	poor - concrete missing on east corner, u/s; hole approx. 1-ft dia. on crest
Rust or Staining	n/a
Spalling	rock walls dislodged
Any Visible Reinforcing	yes, on northeast corner of spillway
Any Seepage or Efflorescence	seepage and flow below concrete cap
Drain Holes	none visible
c. 1) Discharge Channel	stone masonry cascade
General Condition	good
Loose Rock Overhanging Channel	n/a
Trees Overhanging Channel	none to hinder flow
Floor of Channel	stepped stone downstream face of dam
Other Obstructions	minor stone and wood on cascade
2) Discharge channel General condition	natural stream overgrown with vegetation

APPENDIX B

PLAN OF DAM AND PREVIOUS INSPECTION REPORTS

OVER VIEW

LARNER POND

WS Elev. 502.4

DIKE CONTINUES 103 Ft. FROM SECTION 3-3

INLET STRUCTURE

LOSS OF FILL

BM. ELEV. 503.0

Spillway

DEPRESSION 2 FT. DEEP

HEAVY VEGETATION

APPROXIMATE AREA OF SEEPAGE THROUGH MASONRY WALL

DRY MASONRY BLOCKS

CASCADE

WS Elev. 488.3
DEPTH, 1.0 FT.

APPROXIMATE WATERWAY

NOTES:

1. ELEVATIONS SHOWN ARE REFERENCED TO ASSUMED BENCHMARK ELEVATION 503.0 (MS.) AT SPILLWAY CREST.
2. INFORMATION SHOWN BASED ON FIELD SURVEY OF JUNE 26, 1978
3. ⚓ DENOTE POINTS OF SEEPAGE
4. MASONRY WALLS ARE NOT INTENDED TO SHOW ACTUAL CONFIGURATION OR DEPTH.
5. ⏚ DENOTES MARSH OR WET AREAS
6. →#2 INDICATES LOCATION AND DIRECTION OF VIEW OF PHOTOGRAPH

Scale in Feet

SECTION 1-1

SECTION 2-2

SECTION 3-3

FIGURE B-1 PLAN OF DAMS AND SECTIONS

METCALF & EDDY, INC.

TOWN OR CITY Dudley DECREE NO. (H) (STORAGE POND) PLAN NO. DAM NO. 1-2-80 08

LOCATION Saw Mill Pond - " Larned Pond. C. C. DOCKET NO.

DESCRIPTION OF DAM El. 100'

Type	Earth - Dry Walls - 120' dyke 8' wide east end dam.
Length	250'±
Height	17'
Thickness top	emb = 28' abt = 28'±
" bottom	emb. = 32'. spill = 32'±
Downstream Slope	1/8 : 1
Upstream "	vert.
Length of Spillway	Depth = El. 99.' Length = 40'.
Size of Gates	El. 83.0 Waste 1½x2
Location of Gates	waste about 30' west spillway - canal to mill - west end.
Flashboards used	None
Width Flashboards or Gates	
Dam designed by	
" constructed by	
Year constructed	

GENERAL REMARKS

Owned by Stevens Linen Associates Inc.
Inspected Jan. 7, 1925 L.O. Marden
" 2-9-27 " "
" 9-2-30 " " - Crawford
" July 27 -'32 " " "
" : Jan. 13, 1937 - " " - Healey
Measured Oct. 19, 1938 E.S. Grover
Inspected April 17, 1939 L.O.M., S.B. Jowell, Healy. M.M.)
" Nov. 29, 1951 - 4 HS.

DESCRIPTION OF RESERVOIR & WATERSHED

Name of Main Stream	Larned Pond.
" " any other Streams	
Length of Watershed	
Width " "	
Is Watershed Cultivated	
Percent In Forests	Letter 9/4/55
Steepness of Slope	
Kind of Soil	
No. of Acres in Watershed	3.39 Sq. M
" " " Reservoir	100 A.
Length of Reservoir	
Width " "	
Max Flow Cu. Ft. per Sec.	
Head or Flashboards-Low Water	
" " " -High "	

GENERAL REMARKS

Patrol: March 16, 1939 - L.H. Sarty - M.A. Tarella
Dec. 6'38 - Crawford says O.K.
Measured: L.H.S. + M.F.H. (10-6-38)
Inspected: Dec. 11, 1940 - W.O.L.
" " 30, 1940 - M.F. [illegible]
" : Dec. 10, 1942 - J.A. Herholz
" : Jan. 21, 1944 - L.O.M.
" : Dec. 10, 1945 - K.M.F.
" " 1, 1947 - L.O.M. - Meagher
" Dec. 2, 1950 - "

PREVIOUS INSPECTIONS (PARTIAL LISTING)

COPY OF INSPECTION CARD ON FILE AT THE MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS, DISTRICT OFFICE, WORCESTER.

(H)

INSPECTION REPORT & DATA FOR DAMS

Dam No. 14-08
Town: DUDLEY
Stream: BROOK
Pond: LARNER POND
Date: 1/10/72
By:

Owner: STEVENS LINEN ASSOCIATES
His Address: MILL ST. DUDLEY
Function of Dam: STORAGE POND

Location & Access: SAW MILL POND RD. LARNER POND

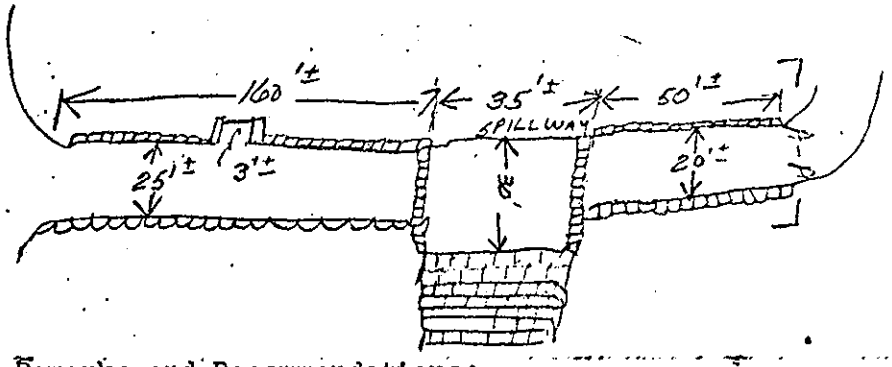
USGS Quad. Webster Lat. 42°03'18" Long. 71°54'15"
Drain.Ar.: 339 Sq.Mi.; Ponds: ___ ac.; Res.Cdam: 10000
Character of D.A.:

CONDITION RATING
Structural: FAIR
Hydraulic: 35 X 1.5
General: FAIR
PRIORITY: NONE

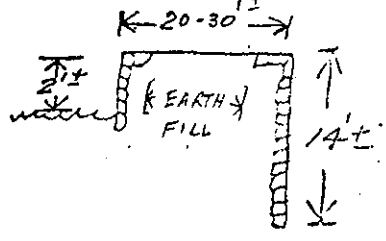
Estimated Discharge Capacity:

General Description of Dam and Discharge Control:
STONE MASONRY WALLS W/ EARTH FILL. 3 GATE OPEN CANNOT SEE ANY BOARDS. WATER 1'± BELOW GOING OVER SPILLWAY. SPILLWAY WALLS 18" ABOVE SPILLWAY.

Sketch (Not to Scale):



A-A END VIEW DAM



Remarks and Recommendations:

STONE MASONRY WALLS FACING THE WATER HAVE BEEN REMOVED IN NUMEROUS SPOTS CAUSING DEPRESSIONS IN DAM FACE FROM 1-2'± IN SPOTS. NO APPARENT DANGER.

Date	By	Comment
1/10/72	VEP RH	

Dam No. 14-08

APPENDIX C

PHOTOGRAPHS

NO. 1 - VIEW LOOKING WEST FROM SPILLWAY

NO. 2 - VIEW LOOKING EAST FROM SPILLWAY

NO. 3 - VIEW EAST OF CASCADE SECTION OF SPILLWAY

NO. 4 - VIEW OF DOWNSTREAM CHANNEL
FROM EDGE OF SPILLWAY

NO. 5 - VIEW OF DOWNSTREAM DAM FACE 40 FOOT WEST OF SPILLWAY

NO. 6 - VIEW OF CONTROL MECHANISM FOR OUTLET CONDUIT

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

Project NAT. REVIEW OF NON FED. DAMS Acct. No. 5864 Page 1 of 6
Subject WORCESTER MASS. AREA Comptd. By LEB Date 7/7/78
Detail LARNER POND Ck'd. By RPW Date 7/11/78
Rev. 7/19/78 LEB

(I) DETERMINE PEAK RUNOFF TO POND

Est Slope: $\frac{710' - 503'}{7.7"(2000'/")} = 1.34\%$

Pond & Swamp Areas:

Larner Pd -	0.04 mi²	} Same Surface Elev. separated by Roads & Culverts
Wallis Pd -	0.04 "	
Unnamed Pd -	0.01 "	
New Pd -	0.05 "	
Hayden Pd -	0.07 "	
Pier. Med. Pd -	0.14 "	
	0.35 mi²	
Swamps (by eye)	0.03 mi²	
	0.04 "	
	0.06 "	
	0.13 mi²	

Total Area Ponds & Swamps = 0.48 mi²
Total Drainage Area = 4.69 mi²
∴ D.A. is 10.2% Ponds & Swamps.

Using M.P.F. - Peak Flow Rate Chart - Larner Pond appears to be between "Leesville Dam" and "Flat & Coastal"

Approx Ratio - $\frac{1.34\% - 0.6\%}{3.0\% - 0.6\%} = 31\%$ of Vert Dist - Use 50%

Say 1100 cfs/mi²

M.P.F. = 1100 × 4.69 = 5159 cfs

$\frac{1}{2}$ M.P.F. = 2580 c.f.s. = Inflow Test Flood

100 yr. storm

For Ave Low Infilt. Rate of 0.18 in./hr. (50% B & 50% C Soils)
Using 6 hour rainfall values, total infiltration = 1.1"
Total 6 hour rainfall for Std. 6 hr. storm = 4.7"

∴ $Q_{100} = 5159\left[\frac{4.7-1.1}{19.0-1.1}\right] = 1040$ c.f.s.

Storage Functions:

Inflow Test Flood: $Q_{F_T} = 2580\left(1-\frac{S_F}{9.5}\right) = 2580 - 272\,S = F_{TF}$

Q_{100} Inflow: $Q_{F_{100}} = 1040\left(1-\frac{S_F}{4.7}\right) = 1040 - 221\,S = F_{100}$

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Project NAT. REVIEW OF NON FED DAMS Acct. No. 5864 Page 2 of 6
Subject WORCESTER MASS AREA Comptd. By LEB Date 7/7/78
Detail LARNER POND DAM Ck'd. By RPW Date 7/11/78
Rev. 7/19/78 LEB

(II) Storage vs Pond Elev.

Larner, Wallis & Unnamed Ponds all interconnected and have same elevations, Incl. adjacent swamps

At Elev. 503 - Water Area = 0.09 mi²
At Elev. 510 - Area = 0.19 mi²

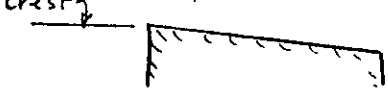
Elev.	Area	Storage Incr. (in-mi²)	Σ Stor. Incr. (in-mi²)	S (in mD.A.)	Storage Function Inf. Test Flood	Inflow Flow
503	0.09		0	0	2580	1070
		1.14				
504	0.10		1.14	0.24		
		1.32				
505	0.12		2.46	0.52		925
		1.50				
506	0.13		3.96	0.84	2352	854
		1.69				
507	0.15		5.65	1.20	2253	775
		1.86				
508	0.16		7.51	1.60	2145	
		2.04				
509	0.18		9.55	2.04	2025	
		2.22				
510	0.19		11.7	2.49	1902	

(III) Discharge @ Dam

(a) Discharge Conduit has minimal value during high flows and is ignored here.

(b) Spillway 37' Wide - assume side contractions at one foot depth = 2(.1) 1 = 0.2'. For higher depths flow can approach crest across training walls & contraction will be reduced. Use net weir width = 36.8'

Spillway is 27' long below crest & drops 0.9 feet
Slope = .03333



Compare Spillway Capacity w/ Critical Flow for unit width: $q = \frac{1.49}{.015}(y)^{1/2}(.1826) = 18.136\, y^{3/2}$ & $q_c = (y^3 g)^{1/2}$

y	1	2	3	4
q	18.14	28.8	37.7	45.7
q_c	5.67	16.0	29.5	43.4

Generally $q > q_c$ on spillway so do not reduce disch. cap. of weir from sharp edge value

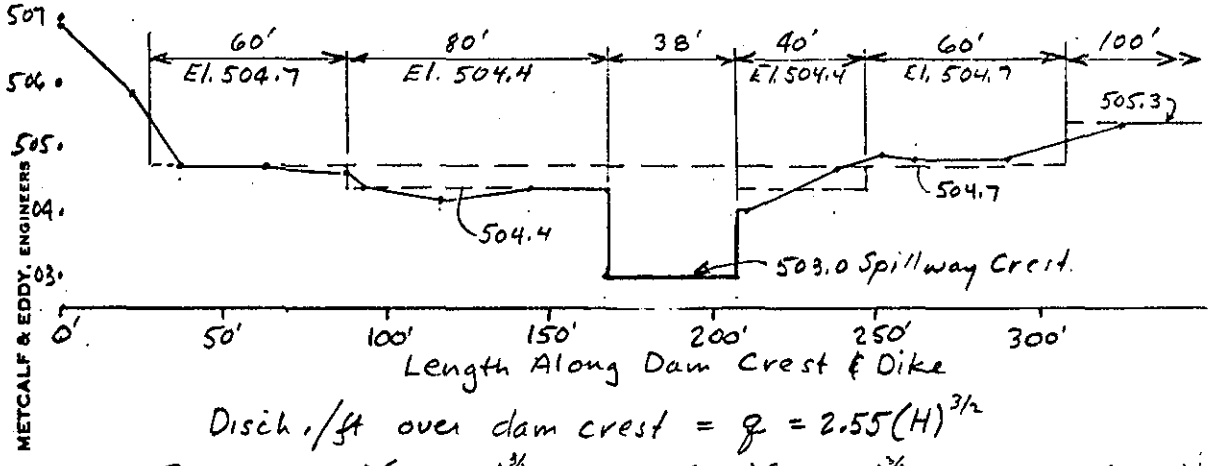
(III) Disch. @ Dam (Cont.)

[Ref. - "Hydr. Tables" - Williams & Hazen]

For $L = 36.8'$, $p = 10'$

Elev.	503.5	504.0	504.5	505.0	506.0	507.0	506.5
h	0.5	1.0	1.5	2.0	3.0	4.0	3.5
Q	45	123	226	347	645	1005	823

(c) Flow Over Crest $q = 2.55(H)^{3/2}$



Disch./ft over dam crest = $q = 2.55(H)^{3/2}$

$Q_1 = 120(2.55)(H-504.4)^{3/2}$; $Q_2 = 120(2.55)(H-504.7)^{3/2}$; $Q_3 = 100(2.55)(H-505.3)^{3/2}$

Elev.	504.7	505.0	505.3	505.5	506.0	506.5	507.0
Q_1	50	142	261	353	619	931	1283
Q_2	—	50	142	219	454	739	1067
Q_3	—	—	—	23	149	335	565
Q_{crest}	50	192	403	595	1222	2005	2915

Project NAT. REVIEW OF NON FED DAMS Acct. No. 5864 Page 4 of 6
Subject WORCESTER MASS. AREA Comptd. By LES Date 7/11/78
Detail LARNER POND DAM Ck'd. By RPW Date 7/11/78
Rev. 7/19/78 LEB

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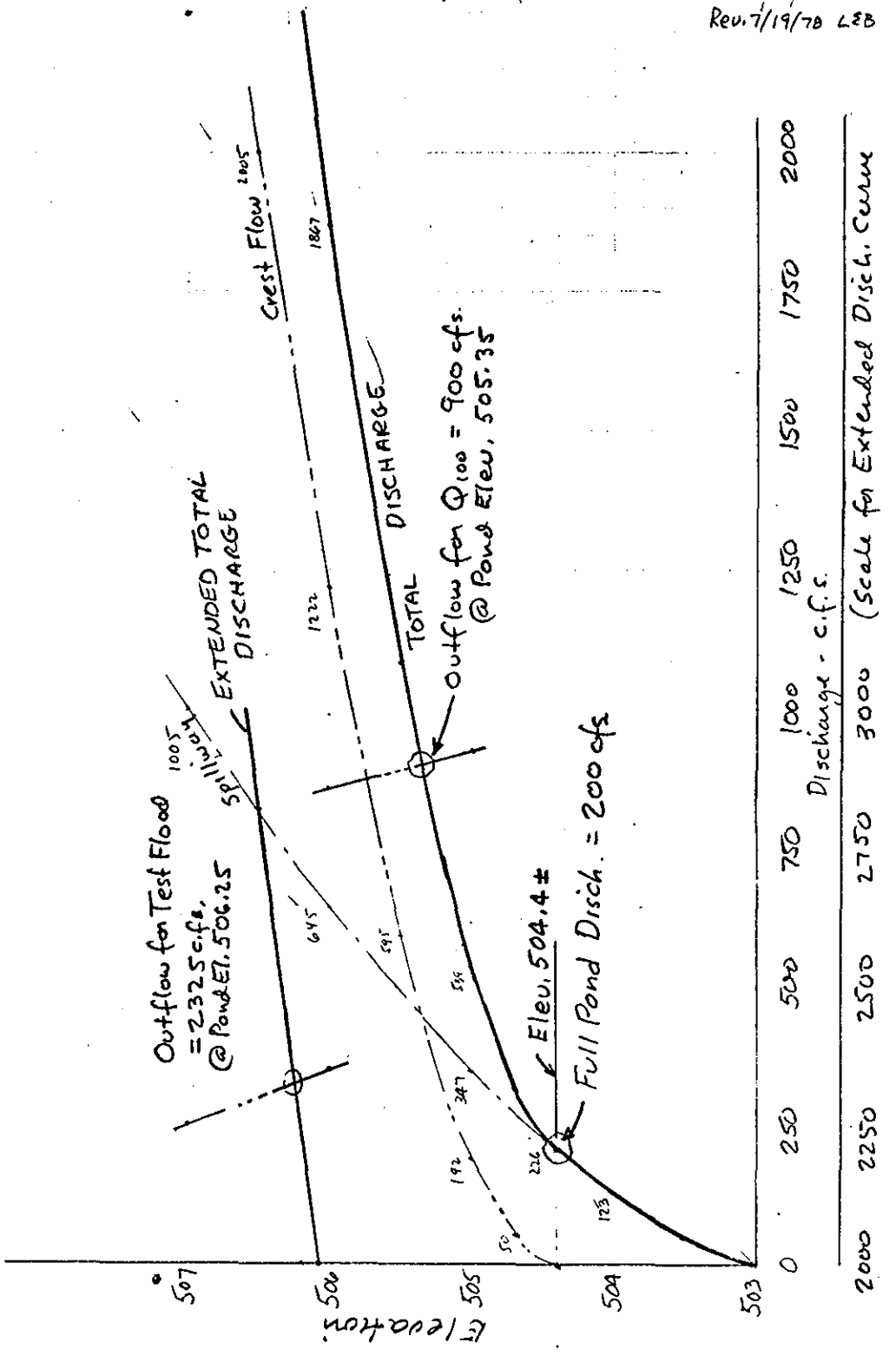


Project NAT. REVIEW OF NON FED DAMS Acct. No. 5864 Page 5 of 6
Subject WORCESTER MASS AREA Comptd. By LEB Date 7/11/79
Detail LARNER POND DAM Ck'd. By EMS Date 7/25/79
Rev. 7/19/79 LEB

(IV) (A) Maximum Discharge

From intersection of Discharge Curve with Storage Function:

Test Flood Outflow = 2325 c.f.s. ✓
with Pond Elev. @ 506.25 ✓

Max Flow on Crest - @ Max Depth of 1.85' - Say 1.9'

$q = 2.55(1.9)^{3/2} = 6.68$ cfs/ft.

Critical Depth $= \left(\frac{q^2}{g}\right)^{1/3} = 1.115'$ ✓

Critical Velocity = 6.0 fps

(B) 100 yr Storm Discharge

From Intersection of Disch. Curve with Storage Function:

"100yr" storm outflow = 900 cfs ✓
with Pond @ Elev. 505.35

(C) Full Pond Discharge

From Discharge Curve Q_{FULL} = 200 cfs.

(D) Sluice Pipe Discharge

Say Pipe Entrance Loss = $0.7 V^2/2g$
Flow Head = $1.0 V^2/2g$
Total Loss = $1.7 V^2/2g$
Ignore Pipe Friction due to short length

Pond Elev. 503; & Pipe Elev. 489; Initial Head = 14'

$V_{14} = \left[\frac{64.4(14)}{1.7}\right]^{1/2} = 23$ fps.; $Q_{14} = 4(23) = 92$ c.f.s

Drainage Area = 4.69 mi² ∴ Peak Sluice Disch. = 19.6 c.s.m.

METCALF & EDDY, ENGINEERS

Project NAT. REVIEW OF NON FED DAM Acct. No. 5864 Page 6 of 6
Subject WORCESTER MASS AREA Comptd. By LES Date 7/11/78
Detail LARNER POND Ck'd. By EMC Date 7/12/78

(V) Dam Failure Flows

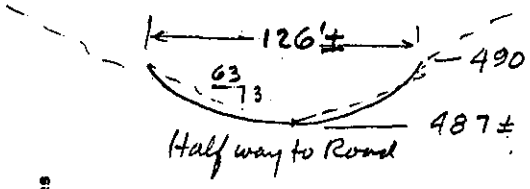
A - Peak Discharge

Assume Pond at Elevation 505.5 (1'± over crest)

Larner Pond Storage: Above Crest - $2.5' \times 0.04 mi^2 \times 640 = 64$ ac. ft.
Below Crest - $8' \times \frac{1}{2} \times 0.04 mi^2 \times 640 = 102$ "
Total @ Failure 166 Ac ft.

$$Q_{P_1} = \frac{8}{27}(0.4 \times 220')\sqrt{g}\,(9.6 + 2.5')^{3/2} = 6228 \text{ c.f.s.}$$ ✓

B - Discharge Valley Rating



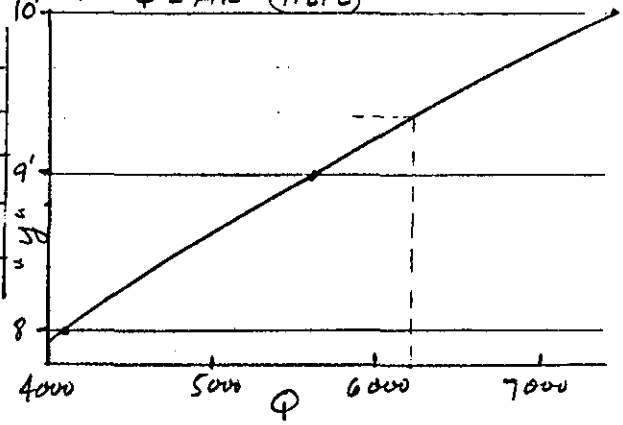
Many Trees - much brush

Say $n = 0.15$, $A = 21y^2$, $P = 42y$

$Q = A\frac{1.49}{n}R^{2/3}S^{1/2}$, $S \simeq \frac{3}{200} = .015$

$\therefore Q = AR^{2/3}(1.212)$

y	4'	6'	8'	10'	9'
A	336	756	1344	2100	1701
P	168	252	336	420	378
$R^{2/3}$	1.587	2.08	2.52	2.92	2.73
Q	646	1906	4105	7442	5619
V			3.05	3.54	3.30



$Q_1 = 6228$, $y = 9.35'$, $A = 1836 ft^2$, $Vol._1 = 200(1836) = 8.4$ Ac ft.

$Q_2 = 6228\left(1 - \frac{8.4}{166}\right) = 5911$ cfs

Wave ≃ 9'

C - Time to Drain

$$\frac{166(43560)}{5911(1/2)(3600)} = 0.7 \text{ hours}$$

D - Rise in Marcia Pond

$$\frac{166 \text{ Ac ft.}}{\pm 90 \text{ Ac.}} = 1.84'$$

APPENDIX E

INVENTORY FORMS